FACT SHEET

Analyzing Hydrolysate

The Newport Chemical Agent Disposal Facility (NECDF) has been designed and constructed to safely destroy more than one thousand tons of liquid nerve agent VX currently stockpiled at the Newport Chemical Depot in Newport, Indiana. The NECDF will use a chemical neutralization process called caustic hydrolysis. The byproduct of the neutralization process is a caustic organic-salt wastewater called hydrolysate. This hydrolysate will require additional treatment before final disposal. The Army's preferred option for final disposition of this caustic wastewater is transportation to a commercial hazardous waste facility where it will undergo final treatment and disposal. Commerical hazardous waste treatment facilities routinely treat materials with characteristics similar to the caustic wastewater generated at the Newport site. Commercial facilities possess the experience and expertise to properly treat the caustic wastewater.

The Army has made a commitment to the public that hydrolysate will not leave the NECDF until the following criteria are achieved:

- It is confirmed that the liquid waste is non-detect for VX, with a Method Detection Limit (MDL) of less than or equal to 20 parts per billion (ppb); and
- It is confirmed that the hydrolysate contains less than 20 parts per million (ppm) of the sodium salt of Edgewood Arsenal compound 2192, known as Na-EA2192.

How does neutralization work?

NECDF operators will neutralize the VX at Newport by adding the agent to a solution of water and sodium hydroxide, a caustic chemical that is the major component of most household drain cleaners. Heating the caustic VX mixture speeds up the neutralization process that destroys the nerve agent. The destruction of VX occurs via two parallel paths. The major pathway, referred to as Reaction 1, consumes approximately 90 percent of the VX and ends with the production of sodium salts of the following breakdown products; ethyl methylphosphonic acid (EMPA) and 2-(diisopropylamino) ethyl mercaptan (thiolamine). Concurrently, Reaction 2, destroys the remaining ten percent of VX producing the sodium salt of EA2192 and ethanol. The sodium salt of EA2192 further reacts with the caustic mixture and decomposes further to the sodium salts of methylphosphonic acid (MPA) and thiolamine. Neutralization irreversibly destroys the chemical agent.

Upon what criteria is the neutralization reaction time based?

The agent will be tested within the neutralization reactor until it is confirmed that the hydrolysate is non-detect for VX (with a MDL of less than or equal to 20ppb) and contains less than 20ppm of the sodium salt of EA2192. The destruction of VX within the neutralization reactor (Reactions 1 & 2 above) occurs within seconds. The break down of the sodium salt of EA2192 created from the destruction of VX occurs within ten minutes. Although the primary reactions only takes seconds to occur, the reactor continues to be heated and agitated for 2.5 hours after completion of agent addition to ensure that the hydrolysate is thoroughly mixed and the sodium salt of EA2192 is adequately destroyed to less than 20ppm.

What does non-detect with a Method Detection Limit of less than or equal to 20ppb mean?

The analytical instruments used at NECDF to analyze for VX within the hydrolysate are capable of detecting its presence using standard Environmental Protection Agency procedures. The analytical procedure is referred to as the MDL. What the MDL does is give a yes or no indicator that agent is or is not present above the MDL limit (20ppb). Once the caustic wastewater undergoes on-site laboratory analysis at NECDF and is confirmed to contain no VX

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Analyzing Hydrolysate (continued)

above 20ppb, it is non-detect.

To develop a better understanding of MDL, consider the example of how citizen band (CB) radios are used. When the squelch is set low you hear static, but you are able to pick up faint stations. When you raise the squelch, the static disappears; however, you cannot receive weak stations. In this case, when the squelch is set low you would have a detect for a station, and with the squelch set higher, you would have a non-detect for a station.

Why 20ppb?

The State of Indiana, through the Indiana Department of Environmental Management, requires that 99.9999% of the VX be destroyed by measurement. The NECDF neutralization process exceeds this requirement by requiring the hydrolysate to be non-detect for agent with an MDL of less than or equal to 20ppb.

The Army requirement for caustic wastewater to be non-detect with an MDL no greater than 20ppb evolved from the Department of the Army desire that the public, workforce, and environment be adequately protected. This is very similar to the process used to test the quality of well. A printed analysis of the test results provides a listing of the various chemicals, compounds and minerals found in the well water, as well as the levels at which they are found in the sample. The results also provide levels of concern for the potentially hazardous substances determined present in the sample. The concern levels are developed based on findings that levels found in the water supply below this amount are considered safe for human consumption. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) has calculated that an exposure to hydrolysate with a VX concentration less than 80ppb would cause no observable nerve agent exposure signs or symptoms (USACHPPM, 2000). However, to best protect the workers and the public, the U.S. Army chose to impose the more conservative requirement, non-detect for agent with an MDL no greater than 20ppb, on hydrolysate transported from the NECDF for final treatment and disposal.

Conclusion

The analytical instruments used at NECDF are capable of detecting VX in liquid waste far below the 80ppb that USACHPPM has calculated to be safe (see above). In the case of detecting for VX in the material, the extremely sensitive instruments can detect if agent is or is not present above the MDL (20ppb). After achieving a non-detect for agent, the destruction process is complete. After the reaction is completed, excess sodium hydroxide is maintained in the hydrolysate to create a "reactive matrix." A reactive matrix is the creation of environmental conditions that preclude an event from occurring. In this case, the excess sodium hydroxide forms a reactive matrix which provides an environment in which no agent can be present or form over time.